Topic: Reciprocal rule

Question: Differentiate the function.

$$f(x) = \frac{3}{x^3}$$

Answer choices:

A $-\frac{9}{x^4}$

B $-\frac{9}{x^3}$

C $-\frac{9}{x^{10}}$

D $-\frac{9}{x^8}$

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Solution: A

To differentiate a function using the reciprocal rule,

$$\frac{d}{dx}\left[\frac{k}{g(x)}\right] = \frac{-kg'(x)}{[g(x)]^2}$$

where $g(x)$ is the given function and k is a constant. In the given function

$$f(x) = \frac{3}{x^3}$$

$k = 3$ and $g(x) = x^3$. So the derivative is

$$f'(x) = \frac{-(3)\left(3x^2\right)}{\left(x^3\right)^2}$$

$$f'(x) = \frac{-9x^2}{x^6}$$

$$f'(x) = -\frac{9}{x^4}$$

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Topic: Reciprocal rule

Question: Differentiate the function.

$$f(x) = \frac{4}{x^2 - 1}$$

Answer choices:

A $$f'(x) = \frac{-4x}{x^2 - 2x + 1}$$

B $$f'(x) = \frac{-4x}{x^4 - 2x^2 + 1}$$

C $$f'(x) = \frac{-8x}{x^4 - 2x^2 + 1}$$

D $$f'(x) = \frac{-8x}{x^2 - 2x + 1}$$

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Solution: C

To differentiate a function using the reciprocal rule,

$$\frac{d}{dx}\left[\frac{k}{g(x)}\right] = \frac{-kg'(x)}{[g(x)]^2}$$

where $g(x)$ is the given function and k is a constant. In the given function

$$f(x) = \frac{4}{x^2 - 1}$$

$k = 4$ and $g(x) = x^2 - 1$. So the derivative is

$$f'(x) = \frac{-(4)(2x)}{\left(x^2 - 1\right)^2}$$

$$f'(x) = \frac{-8x}{x^4 - 2x^2 + 1}$$

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Topic: Reciprocal rule

Question: Find the derivative.

$$y = \frac{1}{4x^2 - 3x + 9}$$

Answer choices:

A $$y' = \frac{-8x - 3}{\left(4x^2 - 3x + 9\right)^2}$$

B $$y' = \frac{3 - 8x}{\left(4x^2 - 3x + 9\right)^2}$$

C $$y' = \frac{3 - 8x}{4x^2 - 3x + 9}$$

D $$y' = \frac{-(3 - 8x)}{\left(4x^2 - 3x + 9\right)^2}$$

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Solution: B

The reciprocal rule is a special instance of the quotient rule where the numerator of the function is a constant. It says that the derivative of the rational function will be the negative derivative of the denominator, divided by the square of the denominator.

$$y' = \frac{-\frac{d}{dx}\left(4x^2 - 3x + 9\right)}{\left(4x^2 - 3x + 9\right)^2}$$

$$y' = \frac{-(8x - 3)}{\left(4x^2 - 3x + 9\right)^2}$$

$$y' = \frac{-8x + 3}{\left(4x^2 - 3x + 9\right)^2}$$

$$y' = \frac{3 - 8x}{\left(4x^2 - 3x + 9\right)^2}$$

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